JPSS Soundings Product Program and Future Development

Mitch Goldberg, Program Scientist

August 2015 JPSS Science Meeting

REWIND TO JULY 7- 9, 2011 -- SOAT MEETING

SDR Validation Priorities

- SDR comparisons with IASI, AIRS, AMSU.
- SDR comparisons with airborne sensors for absolute calibration as long as SI traceability can be demonstrated.
- SDR comparisons with high quality radiosondes (DOE ARM Sites) via RTM
- SDR comparisons with NWP models
- Eigenvector analysis of SDRs
- ATMS asymmetry and limb adjustments

EDR Validation Priorities

- NPROVS up and running to evaluate the EDRs
- Intercompare with NDE NUCAPS retrievals (based on AIRS science team code), AIRS and IASI retrievals and other alternatives
- Intercompare ATMS only retrieval with NDE MIRS
- Some bias corrections
  - If AIRS, IASI and CrIS are in good agreement, we should come up with a good traceable approach for bias corrections

But NWP community are assimilating the radiances, who cares about the EDRs?

- We do!!
- Why - a successful and robust EDR algorithm will result in improved SDR radiance assimilation and perhaps use of EDRs
- Meeting the CriS/ATMS EDRs threshold and pushing towards objective requires accurate surface emissivity retrieval, cloud detection, cloud clearing and accounting for trace gases.
- These are also essential for optimal radiance assimilation
- Right now - radiance assimilation is suboptimal:
  - Poor surface emissivity, do not use channels over land
  - Discard most of the channels because of cloud contamination.
  - Water vapor channels are not treated properly – over tuned.
- Its important to engage the NWP community

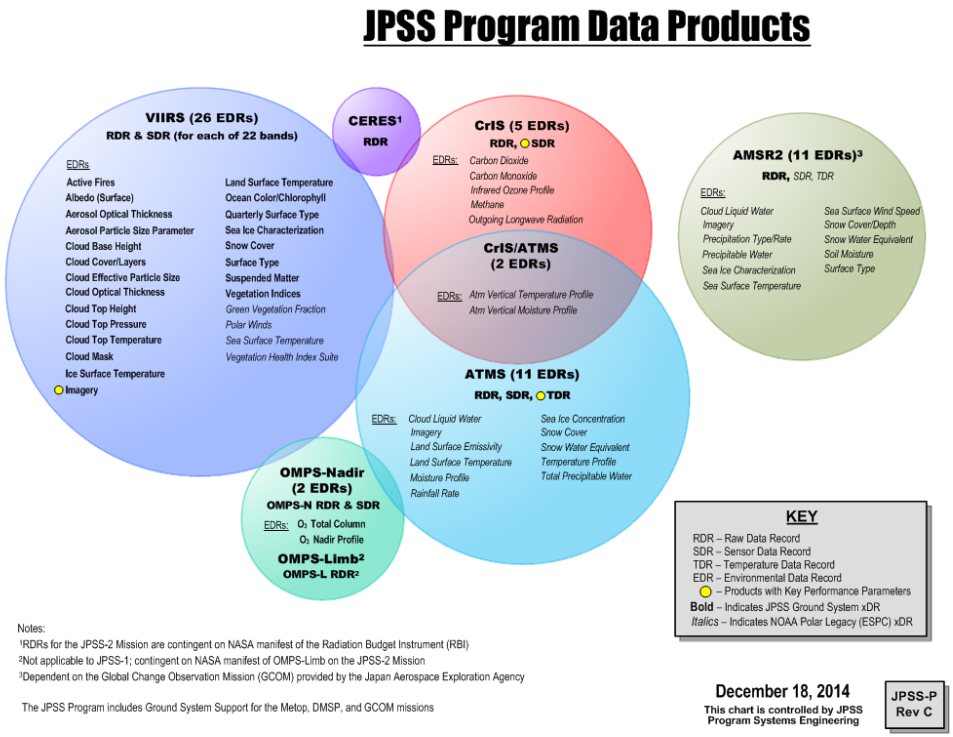
Summary

- We have a great team.
- Highest confidence that we will succeed.
- Make use of lessons learned from AIRS and IASI

Back to the present

Challenge

- User Readiness: Products to Applications
- Ensure users are ready for NPP/JPSS data and improve their key operational and research product and services
  - ✓ Severe weather forecasts and warnings
  - ✓ Aviation weather forecasts and warnings
  - ✓ Improve fire and air quality forecasts and warnings
  - ✓ Improve warnings and prediction of poor water quality in coastal regions
  - ✓ Improve drought, precipitation, snow and ice assessments and predictions
- Periodic feedback from keys users on the impact of NPP/JPSS data and to identify improvements needed for products and applications

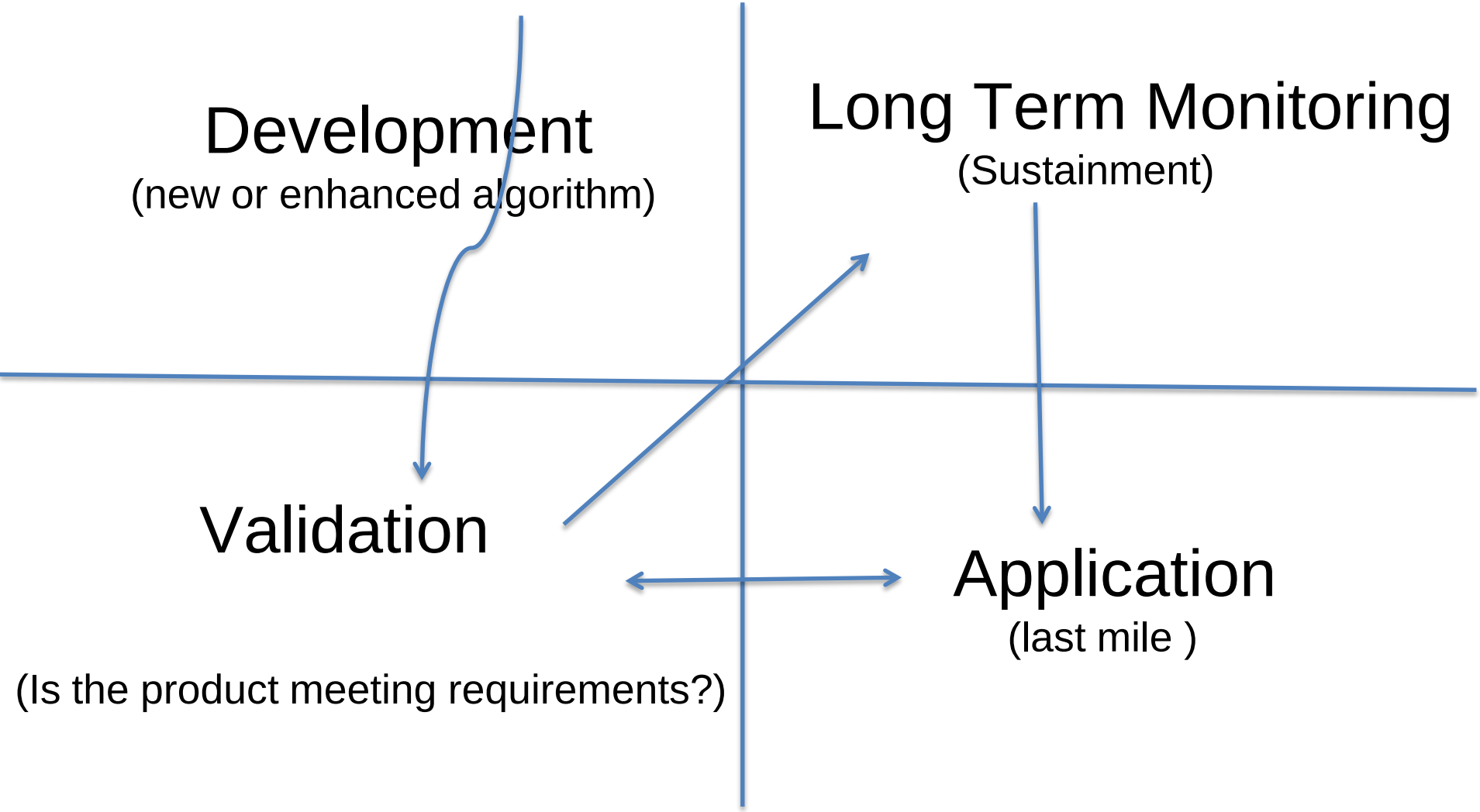


What is the Proving Ground & Risk Reduction Program for JPSS?

The JPSS Proving Ground and Risk Reduction (PGRR) program's primary objective is to maximize the benefits and performance of NPP/JPSS data, algorithms, and products for downstream operational and research users (gateways to the public) through:

- Engaging users to enhance/improve their applications through the optimal utilization of JPSS data.
- Education, Training and Outreach
- Facilitating transition of improved algorithms to operations.
- Detailed characterization of data attributes such as uncertainty (accuracy and precision) and long-term stability
- Provides user feedback to the cal/val program

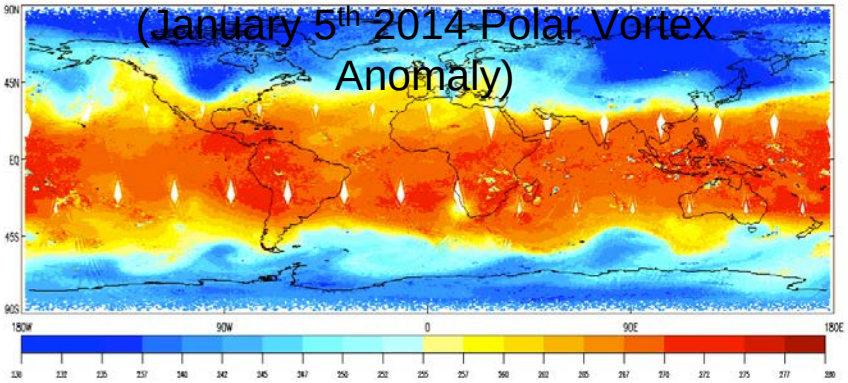
Lifecycle


Development
(new or enhanced algorithm)
Long Term Monitoring
(Sustainment)
Validation
Application
(last mile)
(Is the product meeting requirements?)

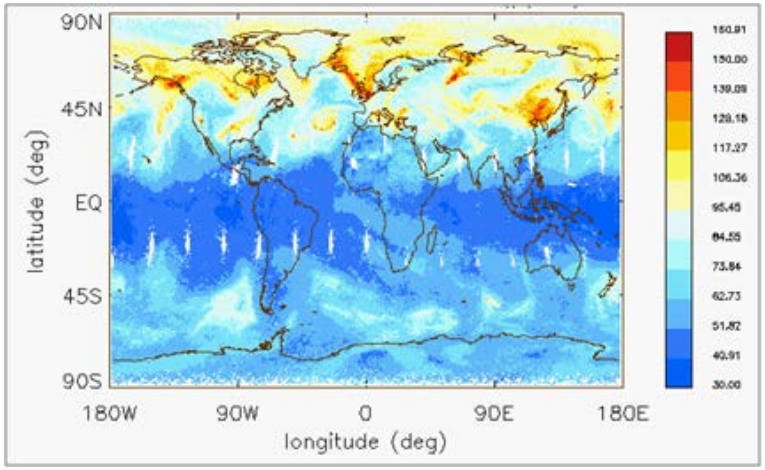
Sounding

- Assist WFOs to make better use of NUCAPS temperature and moisture soundings
- Support NWS/NCEP plans to improve data assimilation of radiances in cloudy conditions
- Use NUCAPS to solve for or derive trace gases

NUCAPS Temperature retrieval @ 500mb



NUCAPS Ozone retrieval @ 500mb



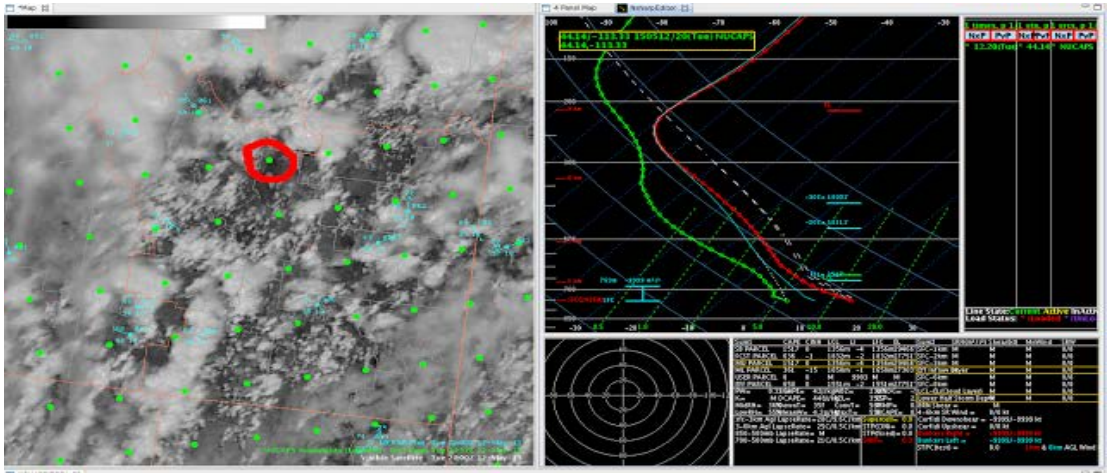
USER ENGAGEMENT PROJECTS

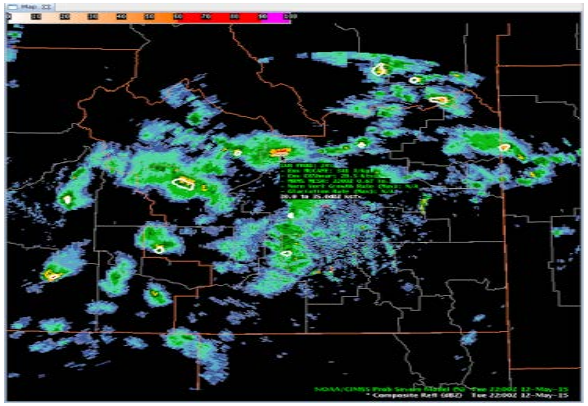
- NUCAPS IN AWIPS - Organized Initiative, Working with WFOs, we are providing training, we participate in the 2015 Hazardous Weather Testbeds - Very successful.

- NWS training liaison we hired from CIRA

NUCAPS Evaluated in NWS Hazardous Weather Testbed (HWT)

- Background
  - What is the HWT: a joint testbed in Norman OK managed by the NWS Storm Prediction Center, the NWS Weather Forecast Office and the National Severe Storms Laboratory
  - Purpose: plan and execute operational tests focused on national hazardous weather needs
  - Spring Experiment: annual, 5-week test periods. Researchers, forecasters, and broadcast meteorologists evaluate emerging research concepts and tools through experimental forecast and warning generation exercises. NUCAPS was a key focus area in the Spring Experiment 2015





Examples of Forecaster feedback

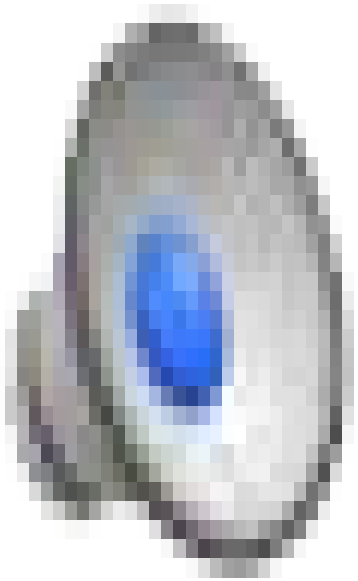
Waiting for deep convection to start. Denver's 18z special sounding showed a strong inversion around 700mb. The 20Z NUCAPS showed the lower levels not quite fully mixed. NUCAPS increased confidence that deep convection would occur but not quite yet. (comment edited)

NUCAPS sounding shows the presence of a cold pocket aloft and relatively low precipitable water values around a half an inch confirm elevated convection along with the scattered reports of severe hail in eastern Idaho.

A VIIRS Satellite Pass at 1944Z provided a NUCAPS Profile near some developing storms in Texas. It provided a nice snapshot of the atmosphere in between [radiosonde] soundings.

AWIPS-2 NUCAPS Training on Youtube

Thanks to Scott Lindstrom, Chris Barnet, Brian Motta and others



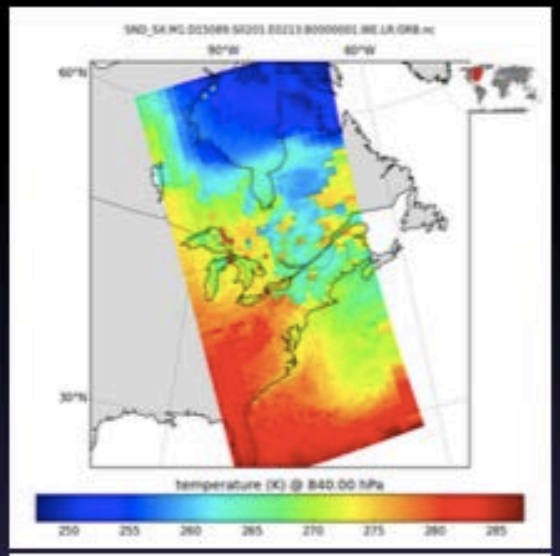
CSPP Software (Apr 2015)

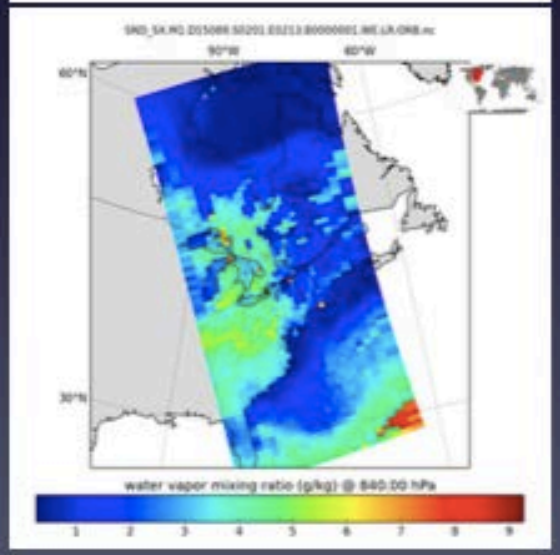
CSPP Software	Product Description
1. SDR	VIIRS, CrIS, and ATMS geolocated and calibrated earth observations.
2. VIIRS EDR	VIIRS imager cloud mask, active fires, surface reflectance, vegetation indices, sea surface temperature, land surface temperature, and aerosol optical depth.
3. HSRTV	Hyperspectral infrared sounder retrievals of temperature and moisture profiles, cloud properties, total ozone, and surface properties.
4. Polar2grid	Reprojected imagery (single and multi-band) in GeoTIFF and AWIPS formats.
5. Hydra	Interactive visualization and interrogation of multispectral imagery and hyper spectral soundings.
6. MIRS	Microwave sounder retrievals of temperature and moisture profiles; surface properties; snow and ice cover; rain rate; and cloud/rain water paths.
7. CLAVR-x	Multispectral imager retrievals of cloud properties; aerosol optical depth; surface properties; ocean properties.
8. NUCAPS	Combined hyperspectral infrared sounder and microwave sounder retrievals of temperature and moisture profiles, cloud cleared radiances, and trace gases.
9. IAPP	Combined infrared sounder and microwave sounder retrievals of temperature and moisture profiles, water vapor, total ozone, and cloud properties.
10. ACSPO	Multispectral imager retrievals of sea surface temperature.

MIRS Examples

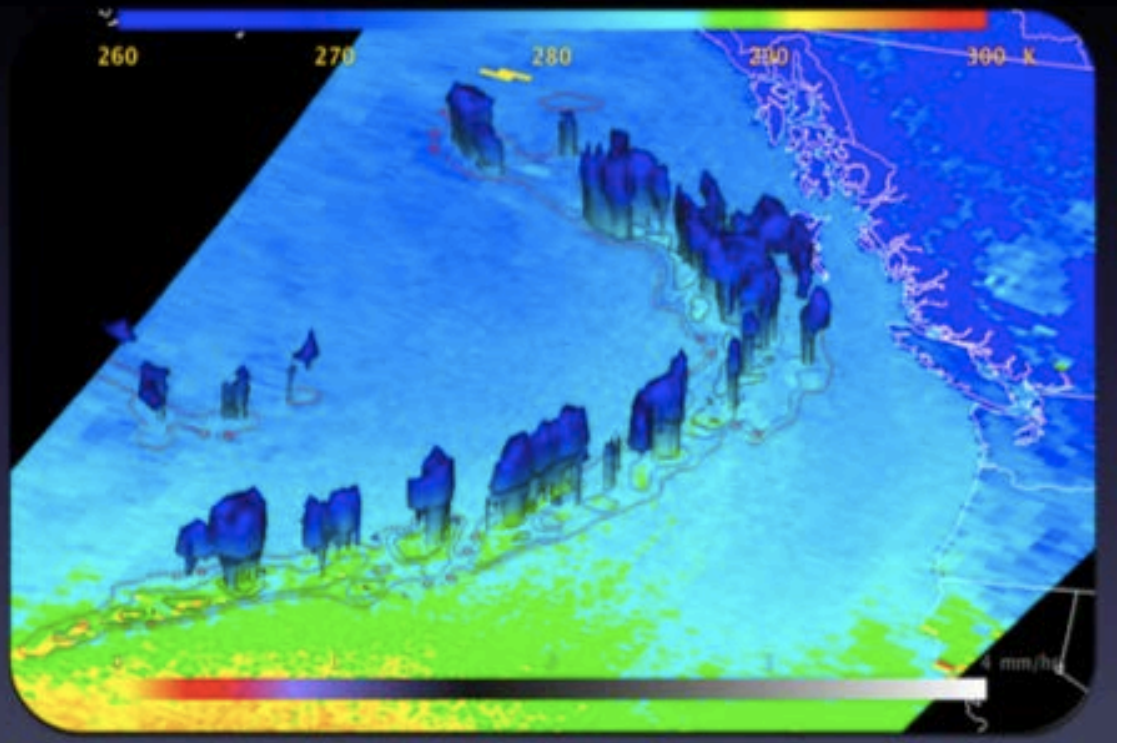
Metop-B 2015/03/30 02:01 UTC
SNPP 2015/03/18 11:03 UTC

Metop-B AMSU/MHS 840 hPa temperature and water vapor

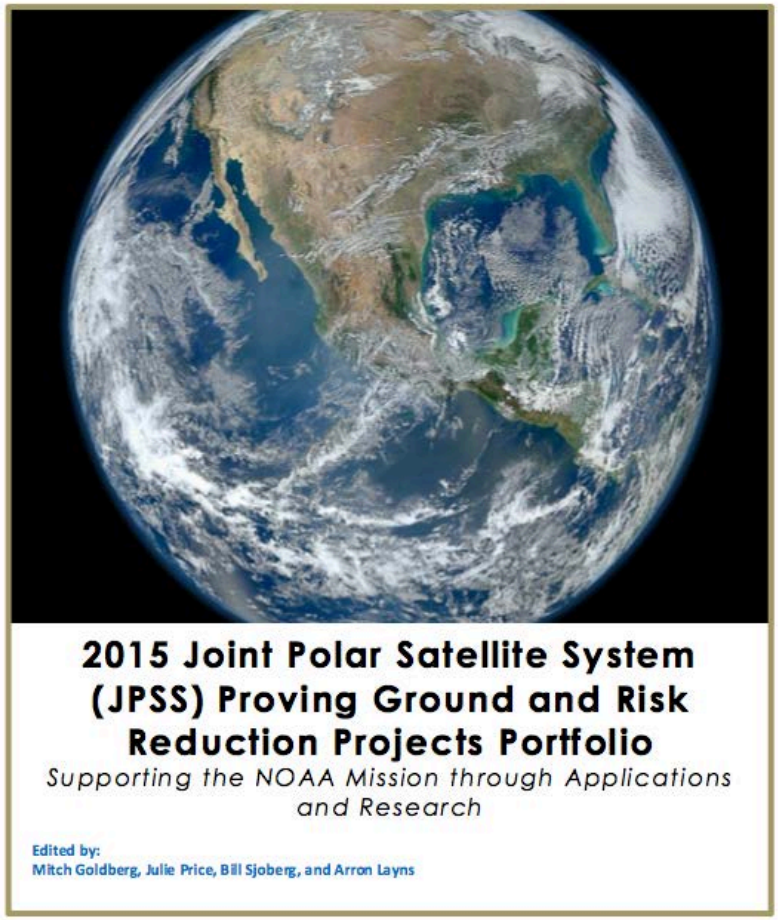




SNPP ATMS Surface Skin Temperature with Rain Rate contours and isosurface of Rain Mass Profile



From the 2015 – 2018 Portfolio



2015 Joint Polar Satellite System (JPSS) Proving Ground and Risk Reduction Projects Portfolio

Supporting the NOAA Mission through Applications and Research

Edited by:
Mitch Goldberg, Julie Price, Bill Sjoberg, and Arron Layns

The contents of this portfolio were current as of June 2015.
Date revised 6/12/2015

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Improving NUCAPS Soundings for CONUS Severe Weather Applications via Data

Daniel T. Lindsey

SYNOPSIS: This project's team members plan to use the NOAA Unique CrIS/ATMS Processing System (NUCAPS) vertical profiles of temperature and moisture from the JPSS satellites and combine them with observed surface observations and numerical model output to produce improved vertical soundings over the CONUS. These modified, "fused" data soundings will be displayed in AWIPS-2 for the National Weather Service.

WHY IS THIS RESEARCH IMPORTANT?

Sharp vertical variations in temperature and moisture are common near the surface prior to warm-season, severe convective events. These sharp gradients, along with the amount and depth of low-level water vapor, can be determining factors in whether convective storms initiate, and if they do, how those storms evolve. One of the key uncertainties on many days when severe weather is possible is whether the low-level temperature inversion, or "cap", will be eliminated due to daytime heating of the earth's surface or cooling above the surface. Currently, the only observations having adequate vertical resolution of temperature and moisture for severe thunderstorm applications are radiosondes. However, the major limitation of radiosonde data is inadequate temporal and horizontal resolution. Balloons are launched only at 00 and 12 UTC (and occasionally at 18 UTC), and the launch sites are 300-500 km apart in the central U.S.

Advancing Hyperspectral Sounder Applications in the Direct-Broadcast Environment

Elisabeth Weisz

SYNOPSIS: BY performing a rigorous validation and evaluation of the UW hyperspectral (dual-regression) retrieval system and the NOAA Unique CrIS/ATMS Processing System (NUCAPS), project team members aim to address concerns raised by users on how to best use these retrieval systems:. In addition, project team members will characterize product performance, such as attributes of accuracy and precision and their stability over time (both short- and long-term). This will contribute significantly to our continued efforts to serve DB users by making the best possible data products available.

WHY IS THIS RESEARCH IMPORTANT?

Hyperspectral infrared sounders, such as AIRS (Atmospheric Infrared Sounder) on EOS-Aqua, IASI (Infrared Atmospheric Sounding Interferometer) on MetOp-A and MetOp-B, and CrIS (Cross-track Infrared Sounder) on Suomi NPP (S-NPP), measure the top-of-atmosphere (TOA) radiance emitted by the Earth system with very high spectral resolution using several thousand channels. The great advantage of high spectral resolution is an increased sensitivity to changes in the vertical atmospheric column (from surface to TOA). Thus, hyperspectral measurements can be inverted into vertical temperature, moisture and ozone profiles, as well as information describing Earth surface and cloud properties. With hyperspectral sounder retrievals now operationally available from four

The Utility of NUCAPS Retrieved Profiles to Diagnose Extratropical Transition

Emily Berndt

SYNOPSIS: The goal of this proposal is to demonstrate how NUCAPS infrared retrieved temperature, moisture, and ozone profiles can complement the Air Mass RGB by giving forecasters insight about the vertical distribution of various atmospheric variables that are influencing the Air Mass RGB imagery and are important for anticipating a tropical to extratropical transition. Additionally, NOAA G-IV dropwindsondes will be used as a verification dataset to compare to the NUCAPS soundings and Air Mass RGB, especially over data sparse regions.

WHY IS THIS RESEARCH IMPORTANT?

Currently NOAA Unique CrIS/ATMS Processing System (NUCAPS) temperature and moisture soundings are available in AWIPS-II as a point-based display. Traditionally soundings are used to anticipate and forecast severe convection, however unique and valuable information can be gained from soundings for other forecasting applications, especially in data sparse regions. Forecasters at the National Centers (i.e. the National Hurricane Center (NHC), Weather Prediction Center (WPC), and Ocean Prediction Center (OPC)) have GOES-R/JPSS Proving Ground proxy products, such as the Air Mass RGB, to assist in monitoring extratropical transition of hurricanes. These extreme events often occur over the ocean in data sparse regions.

Understanding Emissions and Tropospheric Chemistry Using NUCAPS and VIIRS

Gregory Frost

SYNOPSIS: Project team members will develop an approach using NOAA aircraft field measurements and atmospheric chemical-transport models to deliver products to characterize NUCAPS (CrIS/ATMS) retrieval quality, with the goal of improving the accuracy of the NUCAPS daily global measurements of methane (CH4) and carbon monoxide (CO). The goals are to test and improve the accuracy of JPSS-retrieved data and demonstrate their usefulness in air quality and climate modeling studies.

WHY IS THIS RESEARCH IMPORTANT?

Methane

CH4 is an important climate-forcing agent and mediator of global tropospheric chemistry. Recent assessments using field and satellite data demonstrate significant knowledge gaps about the magnitude, trends, and location of CH4 sources in the US and globally. Current CH4 inventories for the US differ significantly from one another, and many inventories do not capture changes in emission from rapidly evolving sectors, such as fossil fuel production. Changes to drilling technology have significantly decreased the cost of producing oil and natural gas (ONG). Assessing the environmental benefits of natural gas vs. coal depends on accurate knowledge of natural gas leaks in extraction, processing and distribution.

Carbon Monoxide

CO, a regulated pollutant due to its air quality impacts, is produced predominantly by fossil fuel combustion, tropospheric oxidation of VOCs, wildfires, and agricultural burning. Data from aircraft, roadside monitoring, and regulatory networks demonstrate that CO emissions have been declining in US urban areas for many decades as light-duty gasoline vehicles have gotten cleaner (Warneke et al., 2012; Pollack et al., 2012; McDonald et al., 2013). While inventories capture these long-term declines in US CO emissions, inverse modeling using NOAA aircraft observations (Brioude et al., 2011; Brioude et al., 2013) demonstrates that inventories do not accurately quantify the magnitude of US CO emissions.

Howard University Support of NOAA's commitment to the Global Climate Observing System (GCOS) Reference Upper Air Network (GRUAN)

Belay Demoz

SYNOPSIS: The objective of this project is to address the overall Joint Polar Satellite System (JPSS) Proving Ground and Risk Reduction (PGRR) Program goal of maximizing the benefits and performance of the Suomi National Polar orbiting Partnership (S-NPP)/JPSS data, and products. This will be done by providing a well characterized GRUAN standard product for NUCAPS and other S-NPP data validation; enabling the engagement of the GRUAN climate science community in JPSS data products and providing feedback; and facilitating the use of the JPSS data in education and training of future scientists.

WHY IS THIS RESEARCH IMPORTANT?

Lack of proper documentation of upper air atmospheric state variable errors has hampered accuracy of derived climate trend estimates. To mitigate this issue, the GCOS Reference Upper Air Network (GRUAN) sites have started a rigorous documentation of highly accurate upper air soundings on routine and periodic intervals. The central GRUAN objective is to provide high quality observations using specialized radiosondes and complementary remote sensing profiling instrumentation that can be used for validation as a baseline for all other measurements and other purposes (GCOS112; Diamond et al. 2009). Satellite-Sonde validation activities address a component of the GRUAN goal; where GRUAN quality data can be transferred and scaled to global data sets. Satellite-based

Direct Readout Enhancement of Short-Range Forecast Impact for Global and Regional Models

Stanley G. Benjamin and Stephen S. Weygandt

SYNOPSIS: The goal of this research is to more effectively assimilate JPSS and S-NPP satellite data in rapidly updating (hourly) mesoscale and global models via application of direct readout data with lower latency. Enhanced skill for these rapidly updated short-range forecasts means improved decision-support guidance for hazardous weather, such as severe thunderstorms including aviation hazards (turbulence, icing, ceiling, visibility, convection for air-traffic management).

WHY IS THIS RESEARCH IMPORTANT?

The Rapid Refresh (RAP) and High-Resolution Rapid Refresh (HRRR) are closely linked hourly updated NOAA operational mesoscale prediction models (Benjamin et al. 2015, Alexander et al. 2015, respectively) run at the National Centers for Environmental Prediction (NCEP) to improve decision support guidance for weather events that endanger lives and economic activity. The RAP runs at a coarser 13km resolution and provides most of the information for initial conditions for the 3km HRRR model. Because of the increased water domain coverage of RAP compared with its predecessor, the RUC, satellite radiance data are playing an important role in the RAP assimilation and forecast skill, also affecting HRRR skill. In 2013, RAP was updated at NCEP to use hybrid variational/Ensemble Kalman Filter (EnKF) assimilation within GSI, using ensemble information from

Title: The Cold Air Aloft Aviation Hazard: Detection Using Observations from the JPSS Satellites and Application to the Visualization of Gridded Soundings in AWIPS II

Principal Investigator:
Bradley Zavodsky (NASA SPoRT)

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Nadia Smith (University of Wisconsin/CIMSS/SSEC)
Eric Stevens (University of Alaska Fairbanks/GINA)

Collaborator:
Kristine Nelson (NOAA/NWS Anchorage CWSU)

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- » Version 6.3.7.1 March 5, 2015

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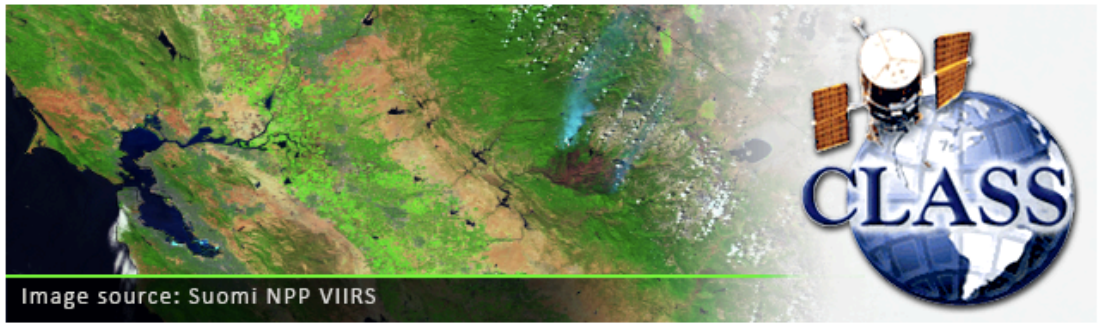


NEWS

Attention CORS users (06/23/14):
Starting January 1, 2014, the National Geodetic Survey's CORS data archived at CLASS now includes GPS+GLONASS data for stations with GNSS-capable equipment. The GLONASS broadcast navigation file (BRDC) is also available for users at the same starting date. (GLO navigation file name example: brdc1680.14g.gz)

CORS data collections include RINEX since 1994 and raw GPS from selected CORS sites since 2004. The original at-sampling rate was retained except where there was only the 30-second decimated rate data. For more info see the CORS CLASS search page.

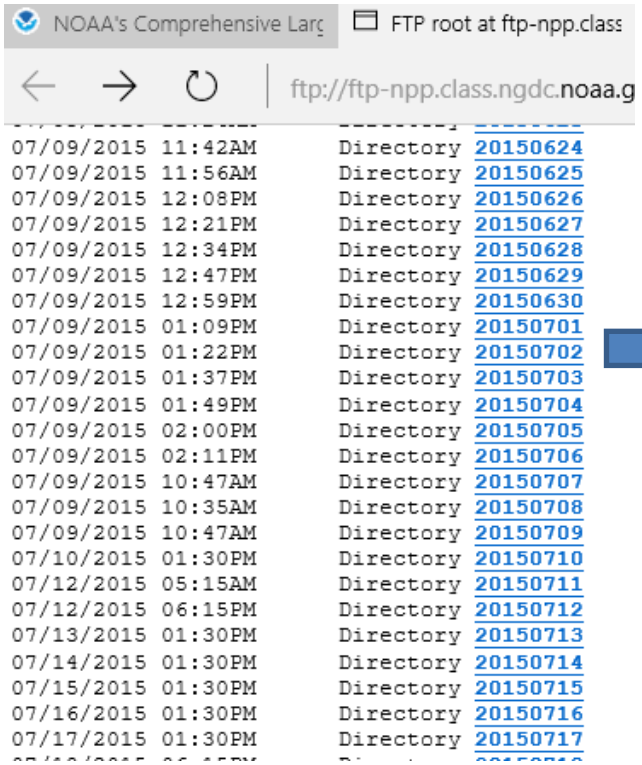
Attention Suomi NPP Users:
The most recent global NPP operational products are now available in daily tar files for quick and easy downloads at: ftp://ftp-npp.class.ngdc.noaa.gov/. Please see the **NPP help page** for instructions. Up to the most recent 85 days of data will be available for direct online access.

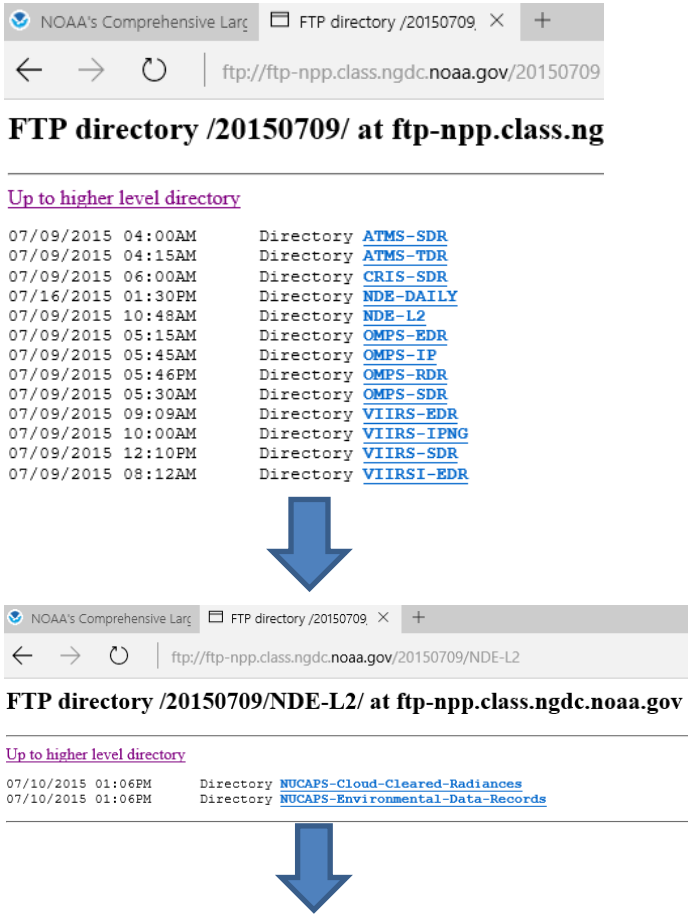
Suomi NPP data access status (11/25/14):
The majority of S-NPP products are now available and can be ordered through CLASS. The ones available to the public will show the begin dates after the product name on the search page. Also, a "quick look" of which products are at which maturity stages can be easily viewed at the **STAR Algorithm Product Maturity Matrix** website. Details of high priority issues related to the data quality are contained in the Readme files provided by the S-NPP Project Scientist. Many of these have recently been updated. Please read these before ordering and using the data.

SEARCH FOR DATA
- Environmental Data from Polar-orbiting Satellites
- Environmental Data from Geostationary Satellites
- Defense Meteorological Satellite Program (DMSP)
- Suomi National Polar-orbiting Partnership (NPP)
- Sea Surface Temperature data (SST)
- RADARSAT
- Altimetry / Sea Surface Height Data (JASON)
- Global Navigation Satellite Systems (GNSS)
- Other - Miscellaneous products in CLASS

SEARCH COLLECTION METADATA
» GO

Easy Access - 85-day rotating server





FTP directory /20150709/NDE-L2/NUCAPS-Environmental-Data-Records/ at ftp-npp.class.ngdc.noaa.gov

Up to higher level directory

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07/09/2015 10:47AM	1,369,025,024	NDE-L2_NUCAPS-Environmental-Data-Records_20150709_00001.tar
07/09/2015 01:01PM	65,021	NDE-L2_NUCAPS-Environmental-Data-Records_20150709_00002.manifest.xml
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07/10/2015 01:06PM	186,891,264	NDE-L2_NUCAPS-Environmental-Data-Records_20150709_00004.tar

Reprocessing

- Successfully completed the first reprocessing of NUCAPS via Chris Barnet and UW team led by Liam Gumley.